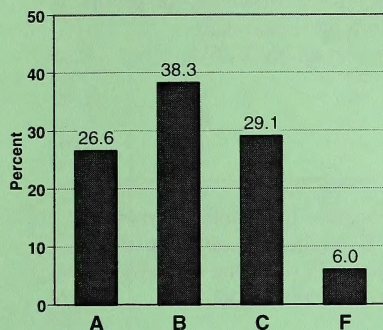


Biology 30

Diploma Examination Results

Examiners' Report for January 1999

School-Awarded Mark

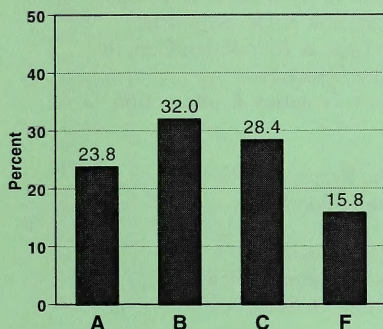


The summary information in this report provides teachers, school administrators, and students with an overview of results from the January 1999 administration of the Biology 30 Diploma Examination. This information is most helpful when used in conjunction with the detailed school and jurisdiction reports that are provided electronically to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined January, April, June, and August results is made available annually.

Description of the Examination

The Biology 30 Diploma Examination consists of 48 multiple-choice questions worth 60%, eight numerical-response questions worth 10%, and two written-response questions worth 30% of the total examination mark.

Diploma Examination Mark

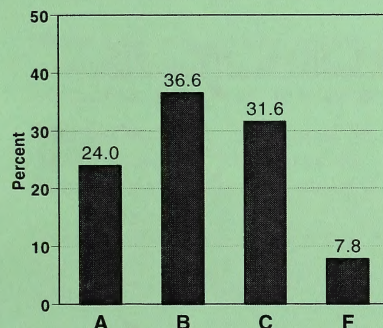


Achievement of Standards

The information reported below is based on the final course marks achieved by 7 198 students in Alberta who wrote the January 1999 examination and received a school-awarded mark. This represents a decrease of 156 students compared with January 1998 and a decrease of 489 students compared with January 1997. (The total number of students writing in the year has remained relatively stable. The April examination sitting decreased the number of students writing both January and June examinations from 1997 to 1998.)

- 92.2% of the 7 198 students achieved the *acceptable standard* (a final course mark of 50% or higher).
- 24.0% of the 7 198 students achieved the *standard of excellence* (a final course mark of 80% or higher).

Final Course Mark



Generally, student achievement in Biology 30 was good. The percentage of students who achieved the *acceptable standard* (92.2%) was slightly higher than was the percentage for January 1998 (90.0%). Most students demonstrated a very good understanding of human nervous and endocrine systems, and of the concepts in cell division, mendelian genetics and molecular genetics tested on this examination. They demonstrated an improvement over previous years in their understanding of population genetics. Some students had difficulty with concepts tested on this examination related to population change over time and human embryonic differentiation and development. The majority of students were able to demonstrate a good understanding of science, technology, and society connections.

Approximately 62.9% of the students who wrote the January 1999 examination were female. Of these, about 93.2% achieved the *acceptable standard* for a final course mark, compared with 90.4% of the male students. Approximately 24.2% of the female students achieved the *standard of excellence* for a final course mark, compared with 23.9% of male students.

Provincial Averages

- The average school-awarded mark was 69.5%.
- The average diploma examination mark was 66.3%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 68.3%.

Approximately 6.9% of the students who wrote the examination in January 1999 and received a school-awarded mark had written at least one

other Biology 30 Diploma Examination during the January 1998 to January 1999 period. This subpopulation (498) achieved an examination average of 61.7%, compared with 66.7% for the population (6 700) who first wrote the Biology 30 examination in January 1999. However, the group of students who rewrote increased their examination score on average by 13.6%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students achieving the *acceptable standard* will obtain a mark of 50% or higher, and students achieving the *standard of excellence* will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score (out of 1) achieved by students who wrote the examination.

Questions are also classified by general learner expectations (GLE). Even though some questions address more than one GLE, only one GLE was selected for the purpose of this report.

Knowledge:

- GLE 1 Nervous & Endocrine Systems
- GLE 2 Reproductive Systems & Hormones
- GLE 3 Differentiation & Development
- GLE 4 Cell Division & Mendelian Genetics
- GLE 5 Molecular Genetics
- GLE 6 Population Genetics & Interaction

Skills:

- SPC Scientific Process Skills and Communication Skills

Science, Technology, Society:

- STS Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPC	STS
MC1	C	0.756	✓						✓	
MC2	C	0.755	✓							
MC3	C	0.770	✓							
MC4	C	0.714	✓							
MC5	A	0.815	✓						✓	
MC6	C	0.731	✓							
MC7	D	0.753	✓							
MC8	B	0.641	✓							✓
MC9	D	0.733	✓							
MC10	A	0.766	✓							✓
MC11	B	0.302	✓							
MC12	B	0.808	✓							✓
MC13	D	0.607	✓							✓
NR1	236	0.454		✓					✓	
MC14	B	0.822		✓						
NR2	1432	0.636		✓						
MC15	A	0.683			✓					✓
MC16	D	0.694			✓					✓

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPC	STS
MC17	D	0.738		✓						✓
MC18	C	0.777			✓					✓
MC19	C	0.607		✓						✓
MC20	B	0.599							✓	✓
MC21	C	0.705				✓				✓
MC22	D	0.728				✓			✓	
MC23	D	0.478					✓			✓
MC24	B	0.757				✓				✓
MC25	D	0.672			✓					
MC26	D	0.531				✓				
MC27	D	0.586				✓			✓	
MC28	A	0.629				✓			✓	
MC29	B	0.853				✓				✓
MC30	B	0.836				✓			✓	
NR3	25	0.733				✓			✓	
MC31	B	0.570				✓			✓	✓
MC32	D	0.623				✓			✓	
MC33	A	0.810					✓		✓	
NR4	0.50	0.823				✓			✓	✓
MC34	C	0.619				✓				✓
MC35	C	0.799				✓			✓	
MC36	A	0.699				✓				
MC37	B	0.817				✓			✓	
NR5	0.25	0.624				✓			✓	
MC38	B	0.864				✓			✓	
NR6	0.25	0.858				✓			✓	
MC39	D	0.894					✓			
MC40	A	0.771					✓		✓	
MC41	A	0.650					✓			
MC42	D	0.799					✓			
MC43	D	0.517						✓	✓	✓
MC44	A	0.859						✓	✓	
NR7	10.3	0.192						✓	✓	✓
MC45	C	0.790						✓	✓	✓
MC46	C	0.584						✓	✓	✓
MC47	A	0.495						✓	✓	✓
MC48	C	0.451						✓	✓	✓
NR8	213	0.835						✓	✓	
WR1	—	0.570		✓(4)	✓(6)			✓(2)	✓(8)	✓(10)
WR2	—	0.613	✓			✓	✓	✓	✓	✓

Subtests: Machine Scored and Written Response (Average by Subtest)

When analyzing detailed results, bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine scored: 38.6 out of 56
Multiple choice: 33.5 out of 48
Numerical response: 5.2 out of 8

Written Response: 17.9 out of 30
Question 1: 6.8 out of 12
Question 2: 9.2 out of 15

Raw Score Averages for Machine-Scored Items and Written-Response Question 1 by General Learner Expectations

General Learner Expectations:

GLE 1	Nervous & Endocrine Systems	9.2	out of	13
GLE 2	Reproductive Systems & Hormones	5.9	out of	9
GLE 3	Differentiation & Development	5.8	out of	10
GLE 4	Cell Division & Mendelian Genetics	14.3	out of	20
GLE 5	Molecular Genetics	4.4	out of	6
GLE 6	Population Genetics & Interaction	6.0	out of	10
SPC	Scientific Process and Communication Skills	22.3	out of	34
STS	Connections in Science, Technology, and Society	20.9	out of	33

Multiple-Choice and Numerical-Response Questions

The following table gives results for seven questions selected from the examination and shows the percentage of students in four groups that answered each question correctly. The comments following the table relate to some of the understandings and skills the students may have used to answer these questions.

Percentage of Students Correctly Answering Selected Machine-Scored Questions

Student Group	Question Number						
	MC4	NR2	MC19	MC26	MC32	MC36	NR7
All Students	71.4	63.6	60.7	53.1	62.3	69.9	19.2
Students achieving the <i>standard of excellence</i> (80% or higher, or A) on the whole examination	91.8	92.4	88.5	83.6	91.8	91.9	40.0
Students achieving the <i>acceptable standard</i> but not the <i>standard of excellence</i> on the whole examination	70.3	62.6	58.0	48.8	61.3	68.5	14.9
Students who have not achieved the <i>acceptable standard</i> (49% or less, or F) on the whole examination	44.9	23.6	29.1	23.9	21.4	42.0	4.4

Use the following information to answer the next question.

Observations About a Synapse and Synaptic Transmission

1. Only axon terminals release neurotransmitters.
 2. A neurotransmitter diffuses from an axon terminal across the synapse to the dendrites or cell body.
 3. Many transmissions across a synapse in a short time may cause fatigue of synaptic transmission.
 4. Electron micrographs of a synapse show that there is no direct connection between the axon terminal of a presynaptic neuron and the dendrites or cell body of a postsynaptic neuron.
4. The assumption that axon terminals contain a limited amount of neurotransmitter could account for observation
- A. 1
B. 2
*C. 3
D. 4

*See exam booklet for context information.

Numerical Response

2. Identify the major function, as numbered above, of each of the hormones given below.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

Function:

Hormone: FSH LH Estrogen Progesterone

Answer: 1432

Multiple-choice question 4 required students to correctly match the observation that fatigue of synaptic transmission occurs with the assumption that axon terminals contain a limited amount of neurotransmitter. Most students were able to make this link thereby demonstrating their process skills and knowledge of how synaptic transmission occurs. Students that had difficulty with this question chose other observations about the synapse that would not be a consequence of a limited amount of neurotransmitter. The most common error was to choose observation 2, which describes the diffusion of a neurotransmitter across a synapse. The process of diffusion would not be affected by a limited amount of neurotransmitter.

Numerical-response question 2 required students to identify one function of each of the four main female reproductive hormones from the list provided in the context box*. Students achieving the *standard of excellence* were readily able to identify these functions. Most other students had some degree of difficulty. Students made a variety of errors, but almost all were able to correctly match one or two of the four hormones with the appropriate function.

Use the following information to answer the next question.

In vitro fertilization techniques can enable postmenopausal women (those who have gone through menopause) to have babies. Eggs are removed from a female donor and are fertilized in a culture dish. The early embryo is inserted into the uterus of the postmenopausal woman. The postmenopausal woman requires hormone supplements for implantation and development to succeed.

19. During the first trimester of a pregnancy, an extraembryonic membrane secretes HCG. In a pregnancy resulting from *in vitro* fertilization of a postmenopausal woman, HCG would **not** function normally because the
- A. woman's pituitary would not respond
 - B. placenta would not produce FSH or LH
 - *C. woman would not have a corpus luteum
 - D. placenta would not be permeable to hormones

Use the following information to answer the next question.

The gene for a light-sensitive protein found in red cones and the gene for a light-sensitive protein found in green cones lie side by side on the X chromosome. A third gene for a light-sensitive protein found in blue cones was discovered on chromosome 7. Mutations to any of these genes result in the common forms of colourblindness. The mutant alleles for these disorders are recessive.

26. A valid assumption based on this information is that
- A. all types of colourblindness are sex-influenced
 - B. males may be carriers for all types of colourblindness
 - C. only females may be carriers for blue colourblindness
 - *D. blue colourblindness occurs in males and females with equal frequency
32. Certain disorders result if an extra chromosome is present in all nucleated cells of the body (trisomy) or if a chromosome is missing from all nucleated cells of the body (monosomy). These disorders arise because of nondisjunction, a malfunction that occurs during
- A. DNA replication
 - B. RNA transcription
 - C. telophase of mitosis
 - *D. anaphase of meiosis

Multiple-choice question 19 required students first to recall that the normal function of HCG is to stimulate the corpus luteum in the pregnant woman and then to reason that in a pregnancy resulting from *in vitro* fertilization no corpus luteum would exist since the egg used is from a donor female. Students achieving the *standard of excellence* were readily able to apply their knowledge of course content to a new problem. Most other students had some difficulty. The most common error was the choice of response A, which indicates that these students incorrectly recalled the mechanism by which HCG acts in a pregnant female.

Multiple-choice question 26 required students to analyze information on the location of gene mutations that result in the inheritance of various types of colourblindness in humans and to make a valid assumption that blue colourblindness would affect males and females with equal frequency. Students achieving the *standard of excellence* could readily do this. Most other students had some degree of difficulty with this question. The most common error was the choice that indicated that all types of colourblindness are sex-influenced. These students did not correctly identify that blue colourblindness would not be sex-influenced based on the information given that the mutation causing it is on chromosome 7 (a non-sex chromosome).

Multiple-choice question 32 required students to identify that nondisjunction which results in monosomy or trisomy could occur during meiosis. Of the students that had difficulty identifying when nondisjunction occurred, most chose DNA replication. This indicates that these students may believe that an extra chromosome can be produced (or deleted) during replication of DNA. These students did not recall that during the separation of homologous pairs in Meiosis I nondisjunction, or the non-separation of the homologues, can occur.

Use the following information to answer the next question.

In pea plants, tall (T) is dominant over short (t), and round seed (R) is dominant over wrinkled seed (r). The Punnett square below shows a cross between a heterozygous tall-heterozygous round-seed pea plant and a short-heterozygous round-seed pea plant. Different types of offspring are represented by numbers.

	TR	Tr	tR	tr
R	1	2	3	4
tr	5	6	7	8

36. Which two types of offspring, when crossed, could be expected to produce a population in which 50% of their offspring would be tall and 100% would produce round seeds?

- A. 1 and 8
- B. 2 and 4
- C. 3 and 7
- D. 5 and 6

*See exam booklet for context information.

Numerical Response

7. Based on the information provided, what is the per capita growth rate of the snow goose population between 1968 and 1990?

(Record your answer rounded to one decimal place in the numerical-response section on the answer sheet.)

Answer: 10.3

Multiple-choice question 36 required students first to determine the genotypes of eight plants from a dihybrid Punnett square table. They then had to determine the phenotypic probabilities for each of four different crosses involving these plants and match one of these crosses to the phenotypic probabilities described in the question. Most of the students achieving at the *standard of excellence* could readily solve this two-part dihybrid cross problem. Even a large percentage of the students that failed the examination were able to correctly solve this problem. Those students that incorrectly answered the question most commonly chose plants 2 and 4 as the parent plants. Some of these students may have incorrectly used the phenotypes of plant 2 and 4 to determine the probabilities rather than the phenotypes of the offspring produced by crossing plants 2 and 4.

Numerical-response question 7 required students to correctly calculate the per capita growth rate of the snow goose population between 1968 and 1990, based on the data given in the context box*. Most students in the province found this difficult. The formula for per capita growth rate

appears in the data booklet ($cgr = \frac{\Delta N}{N}$). Based on the formula, the calculation should have been:

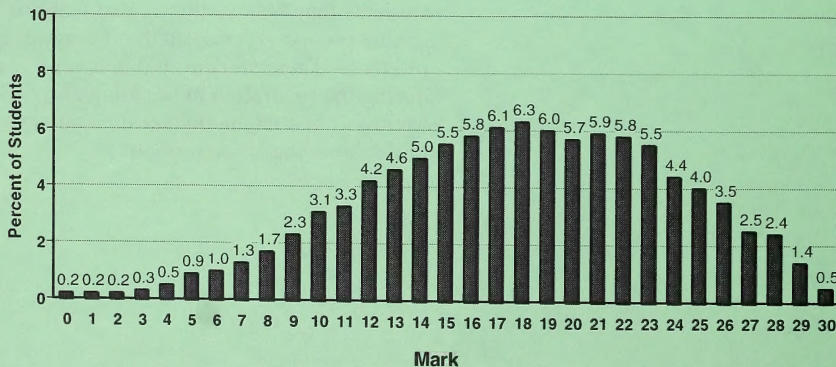
$$cgr = \frac{41\,000}{4\,000} = 10.3. \text{ The most common error was that}$$

students incorrectly used the final population number for N (45 000). Per capita growth is a measure of growth of the population; therefore, N is always the starting population. An understanding of the meaning of the number calculated in per capita growth might help students to avoid this error. A per capita growth rate of 1.0 would indicate no change in the population, a number greater than 1.0 would indicate an increase in the population, and a number less than 1.0 would indicate a decline in the population.

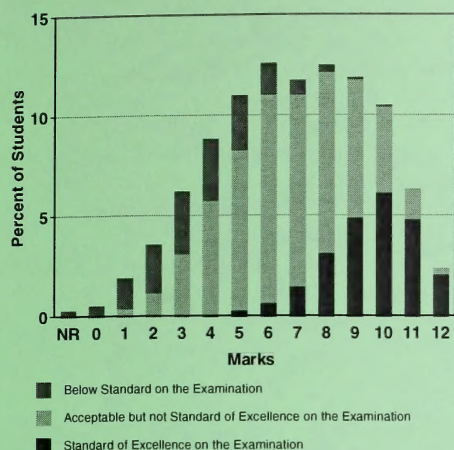
Written-Response Questions

Of the students who wrote the January 1999 examination, 0.2% received no marks for both written-response questions, 71.3% received 15 marks or more out of 30, and 18.6% received 24 marks or more out of 30. The average for the written-response questions was 59.6%.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



For **question 1**, approximately 99% of the students who wrote this examination received some marks on this process skill question relating to declining sperm counts in humans and their possible link to environmental chemicals that are estrogen-mimicking. Aspects of this environmental issue that were presented included hypothesizing about a cause of declining sperm count, presenting the regulation of Sertoli cells development in a flow chart, calculating the percentage decrease in sperm count for one population and predicting the effect on the population of declining sperm counts, linking infertility to declining sperm counts, and, finally, exploring the direction needed for further research to establish a cause-and-effect relationship.

The mean for part a. was approximately 62%. Most students were able to correctly indicate the

hypothesized effect of estrogen-mimicking compounds on sperm counts, but they did not complete their hypothesis by explaining why this might occur.

The mean for part b. was approximately 51%. This indicates that most students have some degree of difficulty communicating hormone action in a flow chart. Those students that answered part i. by using a flow chart were reasonably successful. Some students incorrectly used a graph or a description rather than a flow chart to answer the question. Many students did not communicate their answer to part ii. on the flow chart as required; instead, they wrote a description of the effects of estrogen-mimicking compounds on FSH production and Sertoli cell development. Some students did not clearly communicate the effects of the hormones using solid lines and/or positive signs for stimulatory effects and dashed lines and/or negative signs for inhibitory effects.

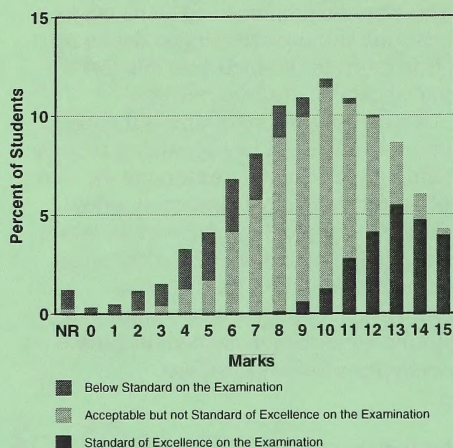
The mean for part c. was approximately 36%. In this question, students were asked to describe a possible reason for the greater sensitivity of fetuses to estrogen-mimicking compounds when compared with adults. The context box gave one possible specific effect the students could have used in answering this question. Most students did not relate the fixing of the number of Sertoli cells in the fetus to the observation that the estrogen-mimickers have little effect on an adult. Most students gave vague answers to this question that did not address the comparative aspect of the harmful effect of the compounds on the fetus and an adult.

The mean for part d. was approximately 62%. Most students were able to predict a possible effect on French society or the French population of a declining sperm count. Many students had difficulty calculating the percentage decrease in the sperm count from the 1973 count to the 1992 sperm count.

The mean for part e. was approximately 55%. Most students were able to describe at least one specific reason for a low sperm count resulting in infertility. Some of the reasons students gave were vague rather than specific.

The mean for part f. was approximately 69%. Most students were able to pose a question that would need to be answered to determine a cause-and-effect relationship. They were then able to explain how the answer to that question could be used to evaluate whether there was a cause-and-effect relationship. This is a very important science process skill. Some of the students that had difficulty on this question appeared to believe that the cause-and-effect relationship was already firmly established; therefore, they did not understand the intent of the question. Some of the students that had difficulty were unable to explain how the answer to the question could be used to evaluate the cause-and-effect link between the variables.

Distribution of Marks for Question 2



For **Question 2**, approximately 98% of the students who wrote this examination received some marks on this extended-response question. The question required students to discuss various aspects of the inherited disorder ataxia telangiectasia (AT), that included: producing a sketch of a diagram of the human brain and identifying the area of the brain most affected in AT; explaining risks to AT patients related to mutation; calculating allele and genotype frequencies for AT in the population; and explaining how societal factors or technologies could be used either to decrease the frequency of AT or alleviate the symptoms of AT in patients.

The average on scale one (Science) for this question was approximately 65%. Most students were able to sketch a reasonable

diagram of the brain and show the relative location of some parts of the brain thereby demonstrating appropriate use of visual communication skills in science. Students that had difficulty with this part of the question could not demonstrate that they knew the relative locations of at least four areas of the brain. Most students were able to demonstrate knowledge of the functions of the areas of the brain. However, many students were unable to correctly identify either the cerebellum or the cerebral cortex (motor area in the frontal lobe) as the one area, which, if damaged, could account for all of the symptoms described in AT. A common error was that students equated the AT patient's difficulty controlling eye movement to damage to the occipital lobe, which is primarily involved in interpreting visual stimulation. Students could identify mutagens but had some difficulty in linking abnormal repair processes in AT to cancer. Many students did not relate cancer to abnormal cell division. They also did not link a mutation that causes cancer to an increased rate of cell division.

The average mark on the second scale (Technology and Society) was approximately 54%. Students who did well on this portion of the question were able to communicate clearly the mathematical steps used in determining the two H.W. calculations asked for. Some of these students did not complete the communication by answering the question asked. Most students were able to communicate some of the steps in calculation, but calculation errors were common. A large number of students did not attempt the calculations at all. Students could readily identify technologies that would be appropriate in reducing the incidence of AT or alleviating the symptoms. However, their explanation of how these technologies would work showed that they often confused one technology with another. Students had difficulty explaining how a technology will decrease the incidence of AT in the population. They often believed somatic cell gene alterations affect the incidence of AT in the next generation.

In general, the students demonstrated good communication skills by including written descriptions and explanations, visual communication (sketches), and mathematical communication (H.W.) Their responses were well organized, and they used appropriate scientific terms.

For further information, contact Elisa Rawe (erawe@edc.gov.ab.ca) or Corinne McCabe (cmccabe@edc.gov.ab.ca) at the Student Evaluation Branch at (780) 427-0010. To call toll-free from outside of Edmonton, dial 310-0000.

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